Electrochemical Removal of NOx-Gasses by Use of LSM and LSF Cathodes Impregnated with NOx-Storage Compounds

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Electrochemical removal of NO_x-gasses by use of LSM and LSF cathodes impregnated with NO_x-storage compounds

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Electrochemical reduction of NO_x is a potential method for cleaning exhaust gasses from for example diesel engines. In other studies numerous cathode materials have been investigated for reduction of NO_x, for a review see (1). One of the promising cathode materials for NO_x-removal is lanthanum manganite doped with 15 % strontium (LSM15) (2). However, in order to make electrochemical reduction of NO_x an efficient process there is a need to improve the selectivity of the LSM15 cathodes towards NO_x- reduction.

This present work studies the possibility of improving the selectivity of LSM15 and LSF15 cathodes towards NO_x reduction by impregnating the cathodes with alkali and alkali earth nitrates. It is known from the conventional NSR (NO_x Storage and Reduction) catalysis these alkali and alkali earth nitrates can act as NO_x-storage materials by cycling between the nitrate and the corresponding oxide-compound.

In this study cathodes impregnated with different alkali- and alkali earth nitrates are investigated both in a 3-electrode set-up and as electrodes in porous 11-layer cell stacks, in both cases with CGO as electrolyte. The measurements are made in atmospheres containing 1000 ppm NO, 10 % O_2 and 1000 ppm NO+10 % O_2 in the temperature range 300-500 °C. The effect of combining electrochemical reduction of NO_x with a NO_x storage compound is studied with cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS). Also, the ability of the electrodes to convert NO_x is monitored by prolonged polarization of the electrodes coupled with mass spectroscopy on the outlet gas. Figure 1 and Figure 2 depicts the NO concentration measured by a mass spectrometer during polarization of an un-impregnated and a sample impregnated with KNO_3, respectively. As seen when comparing Figure 1 and Figure 2, there is a clear effect on the NO_x conversion of impregnating the cathodes with KNO_3.

Finally, the cells' microstructure is characterized before and after testing using scanning electron microscopy.

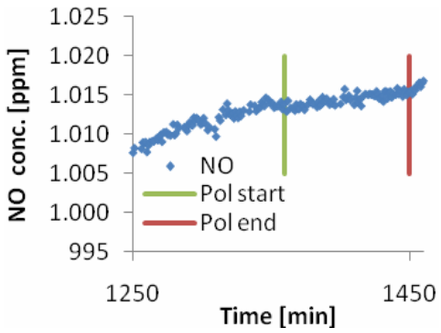

Figure 1: NO concentration in ppm in gas stream after passage through a porous 11-layer cell stack with LSM15-CGO10 electrodes and CGO10 electrolyte. The temperature of the cell stack was 300 °C, the inlet gas 1000 ppm NO in Ar, and no effect on the NO concentration was observed when the stack was polarized at -3V (polarization start and end marked by the green and the red line respectively).

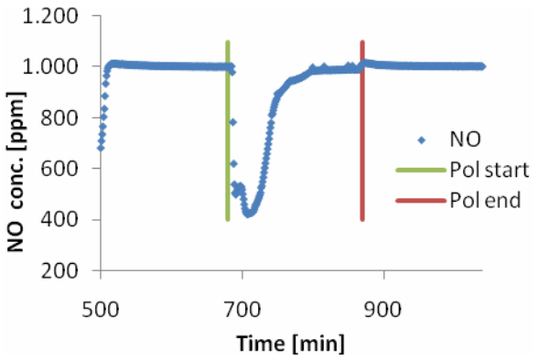

Figure 2: Same set-up as in Figure 1, apart from the porous cell stack tested was impregnated with KNO_3. During polarization at -3V approximately 50% conversion was observed, when the conversion was highest.

REFERENCES

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2. K. K. Hansen, E. M. Skou and H. Christensen, *J. Electrochem. Soc.,* **147** (5), 2007 (2000).